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AUTHOR Legacy, Jim; And Others
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ABSTRACT

This competency-based curriculum unit on soils and fertilizers is one of four developed for classroom use in teaching the turf and lawn services area of horticulture. The four sections are each divided into teaching content (in a question-and-answer format) and student skills that outline taking soil samples, testing samples, preparing soil for turf seedbed, and turf fertility. A list of references precedes a section containing visual aids, student skill checklist, and student activities such as handouts, discussion activities, field trips, crossword puzzles, hands-on experiences, worksheets, tests, and quizzes. Answer keys are provided. (YLB)

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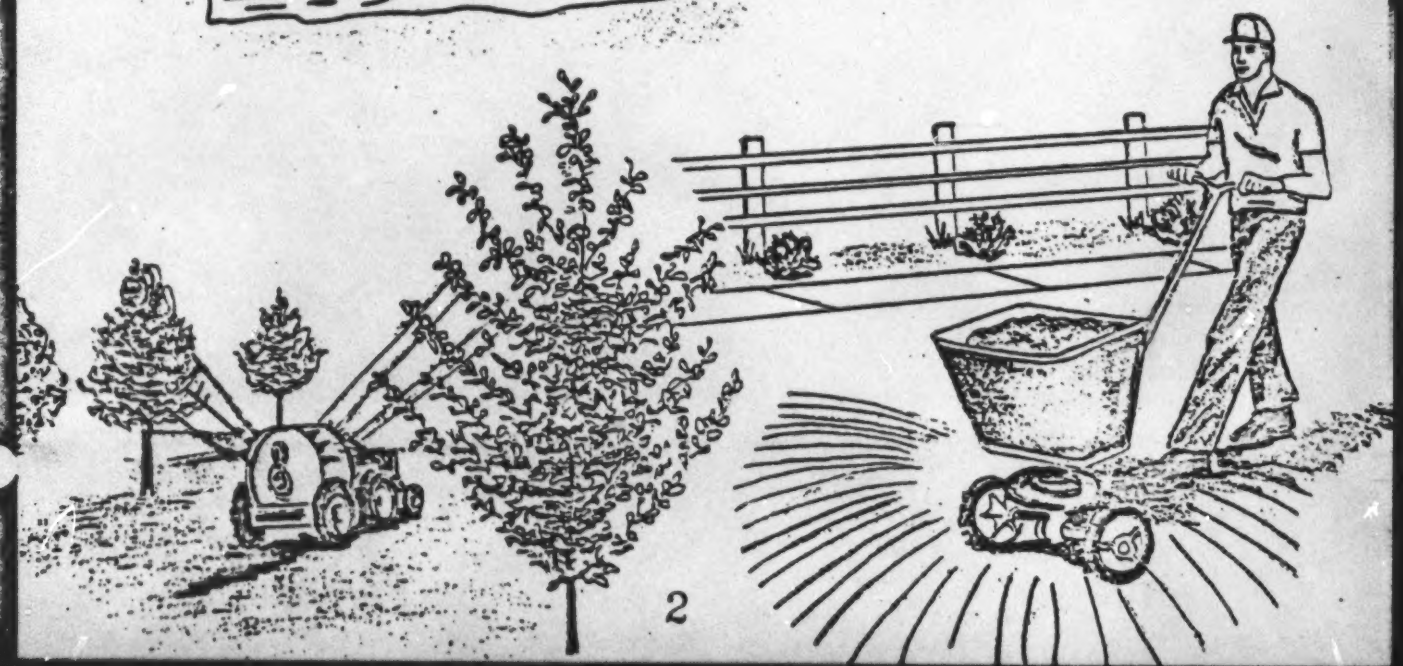
Soils And Fertilizers

Competency Based Teaching Materials in Horticulture



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Listed below are competency based curriculum units developed for classroom use in teaching horticulture. All units are indexed and include teaching content, references, student activities, a skill check list, and visual aids.

LANDSCAPE/NURSERY Tree Identification Developing a Landscape Plan Implementing the Landscape Plan Maintaining the Landscape Nursery Propagation	**GREENHOUSE PRODUCTION & MANAGEMENT** Controlling the Greenhouse Environment Greenhouse Soils Foliage Plants Propagation Sales Cut Flower Production Bedding Plants
TURF AND LAWN SERVICES Identification of Turf Grasses Soils and Fertilizers Planting Turf Grasses Insects and Diseases	**VEGETABLE PRODUCTION** Identification of Cool Season Vegetables Identification of Warm Season Vegetables Vegetable Production Insects, Diseases, and Weeds
FRUIT PRODUCTION (In progress)	

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SOILS AND FERTILIZERS

Contents

TAKE SOIL SAMPLES 1

Problem locations vs. normal locations to be tested, factors to consider when selecting soil test site, soil testing tools, drilling a sample, mix samples, bag samples, label bag, mail the sample, soil treatments, record the sample information

TEST SOIL SAMPLES 4

Test for pH, quick test phosphorus and potassium tests

PREPARE SOIL FOR TURF SEEDBED 5

Influence of soil texture to water movement, tiling and sloping the seedbed, tillage tools, seedbed drainage, seed bed tillage, fertilizer selection, types of spreaders, methods of application

TURF FERTILITY 8

Nutrient levels, interpret soil test results, fertility requirements of turf, calculate maintenance fertilizer

REFERENCES 10

STUDENT ACTIVITIES 11

Soils and Fertilizers

TAKE SOIL SAMPLES

Teaching content: 15 questions; 6 student skills

Question 1 What are the characteristics of a normal site to be tested?

- It would be an average area that has no identifiable problem areas.

Question 2 What is a problem area?

- Wet areas
- Poor producing area
- Any unusual area

Question 3 How many sites per location?

- One per 10,000 sq. ft.
- One per 4 acres if over one acre
- One per problem area

Question 4 What factors should be considered when selecting a site to be tested?

- Sites that will be used for growing purposes should be tested for nutrient deficiencies, etc.

Question 5 What types of tools may be used to test soil?

Alternatives	Factors for Consideration
1. Auger	- Soil moisture
2. Probe	- Equipment available
3. Spade	- Number of samples to be taken

Student Skill 1

DRILL SAMPLE

Steps	Factors for Consideration
1. Drill auger or spade 3" deep	
2. Pull out sample	
3. Place sample in bucket	

Question 6 What is a uniform representative sample?

- A thorough mixture of 5 sample probes per site.

Student Skill 2

MIX SAMPLE

Steps	Factors for Consideration
1. Place 5 sample cores per site in bucket	1. 3 qt. bucket
2. Stir with a stick	2. Don't use hands to mix

Question 7 What type of bag should be used to store the samples?

- Moisture and tear resistant
- Double-thick walls
- Bag size dependent upon size of samples taken

Question 8 How much soil is required in the bag?

- One cup
- One-half bag

Student Skill 3

BAG SAMPLE

Steps	Factors for Consideration
1. Fill sample bag 1/2 full.	1. Use a cup.
2. Fold bag closed.	

Student Skill 4

LABEL BAG

Steps	Factors for Consideration
1. Write date on bag	1. Use a pencil
2. Write customer's name	
3. Write customer's address	
4. Record sample number	
5. Record location (field) number	
6. Record location on map	

Question 9 What has been done to the soil in the past?

- Farm field
- Garden
- Turf

Question 10 How will the site be used?

- Home lawn
- Park
- Golf course
- Garden

Question 11 When and how much fertilizer and lime was applied in past?

- In records
- Ask owner
- Check old soil test results

Question 12 What type of turf is growing?

- Kentucky bluegrass
- Red fescue
- Best grass
- Others

Question 13 Are there any unusual conditions?

- Low areas
- Wet areas
- Near roads
- Droughtiness
- Eroded areas
- Soil texture
- Soil color

Student Skill 5

RECORD SAMPLE INFORMATION SHEET

Steps	Factors for Consideration
1. Record past history	1. Ask owner
2. Record site use	
3. Record fertilizer and lime used in past and date	
4. Record type of turf growing	
5. Record any unusual conditions	

Question 14 How do you properly package the samples?

- Use a box
- Seal box with tape and string

Question 15 What is the address of the soil lab?

- Secure address from local agricultural extension advisor

Student Skill 6

MAIL SAMPLE

Steps	Factors for Consideration
1. Package samples	
2. Address package	
3. Mail--after allowing samples to air dry	

TEST SOIL SAMPLES

Teaching content: 4 questions; 3 student skills

Question 1 How do I use a pH meter?

- Follow directions with pH meter.

Question 2 How do I use the quick test procedure?

- Follow directions with the test kit

Student Skill 1

TEST FOR pH

Steps	Factors for Consideration
1. Obtain air dry soil sample	1. Keep hands from touching soil for accurate results
2. Grind up soil	
3. Follow pH test directions	3. Many pH meters and simple tests are available

Question 3 How do I use the quick test phosphorus procedure?

- Follow test kit directions

Student Skill 2

TEST FOR AVAILABLE PHOSPHORUS

Steps	Factors for Consideration
1. Obtain air dry soil sample	1. Don't touch soil
2. Grind soil	2. Use mortar and pestle
3. Follow test directions	3. Sudbury soil test kits are simple to use, others also available

Question 4 How do I use the quick test potassium procedure?

- Follow test kit directions

Student Skill 3

TEST FOR POTASSIUM

Steps	Factors for Consideration
1. Obtain air dry soil sample	1. Don't touch soil
2. Grind soil	2. Use mortar and pestle
3. Follow test directions	3. Sudbury soil test kits are simple to use, others also available

PREPARE SOIL FOR TURF SEEDBED

Teaching content: 11 questions; 4 student skills

Question 1 How fast does water move into and through the soil?

- Fine, moderately-fine texture--slow movement
- Medium texture--moderate movement
- Moderately-coarse and coarse texture--rapid movement

Question 2 When is tiling and sloping the seedbed necessary?

- Tile poorly drained soils
- Slope seedbed away from buildings

Student Skill 1

DRAIN SEEDBED

Steps	Factors for Consideration
1. Place tile in ground if poorly drained 2. Slope soil away from buildings to put in tile	1. Get professional help

Question 3 How does the soil till up to form a seedbed?

- Clays, fine, and moderately-fine textures are difficult to till when wet
- Medium and coarse textures are easy to fill

Question 4 How do the tillage tools differ in their ability to till the soil?

- Plow--completely turns over the soil
- Disc--makes a fine seedbed
- Rotary tiller--prepares a fine seedbed, tills deeper than a disc
- Leveling is required for all methods

Student Skill 2

SELECT TILLAGE TOOLS

Steps	Factors for Consideration
1. Measure soil texture 2. Determine if turning over soil is necessary 3. Select tillage tool suited to soil	

Question 5 Which method should be used?

Alternatives	Factors for Consideration
1. Plow 2. Rotary tiller 3. Disc	- Soil texture - Soil moisture - Time of year - Erosion hazard - Equipment cost - Necessity of soil to be turned over

Student Skill 3

TILL SEEDBED

Steps	Factors for Consideration
1. Allow soil to become dry	1. Soil must be moist, not bone dry for best results.
2. Till seedbed	
3. Level seedbed	
4. Check for fine, loose seedbed	
5. Stop before soil becomes pulverized	

Question 6 Which fertilizer should be used?

Alternatives	Factors for Consideration
1. Slow release fertilizer	- Cost
2. Blended	- Rate of reaction
3. Liquid	- Ease of application
4. Straight grade	- Availability
5. Bag	
6. Bulk	

Student Skill 4

SELECT FERTILIZER

Steps	Factors for Consideration
1. Determine availability	
2. Calculate cost per pound of nutrient	
3. Determine ease of application	
4. Buy fertilizer	

Question 7 How easy are the spreaders to use and maintain?

- Dry spreaders must be cleaned, calibrated, and lubricated
- Liquid sprayers require precise mixing and ground speed
- Liquid sprayers must be cleaned, calibrated, and lubricated

Question 8 Which method of application should I use?

Alternatives	Factors for Consideration
1. Liquid qpplication	- Cost of equipment
2. Dry application	- Ease of application
	- Ease of maintenance

Question 9 What steps are necessary to follow when selecting fertilizer equipment?

- Determine time required to fertilize the area
- Match equipment to fertilizer selected
- Estimate the cost of owning and maintaining the equipment
- Rent or buy the equipment

Question 10 Which method should I use?

Alternatives	Factors for Consideration
1. Spray	- Cost
2. Broadcast	- Rate of application
3. Band	- Speed of application
	- Ease of application

Question 11 How do I apply fertilizer to my soil?

- Follow instructions with the spreader
- Avoid skipping and streaking

TURF FERTILITY

Teaching content: 3 questions; 2 student skills

Question 1 What nutrient levels does the soil require?

- pH 6.0 to 6.5
- P_1 test optimum 40-50 pounds P_2O_5 per acre
- K test optimum 260-300 pounds K_2O per acre

Question 2 How can one determine the present pH level and the P and K levels in soil?

- They can be determined by soil test results.

Student Skill 1

INTERPRET SOIL TEST RESULTS

Steps	Factors for Consideration
1. Calculate if pH, P, and K are at acceptable levels	

Question 3 How much fertility does turf need?

- Ten pounds of 12-12-12 per 1000 ft^2 applied in September and April
- Additional nitrogen may be applied at 1#/1000 sq. ft. in September, April, June, and August

Student Skill 2

CALCULATE MAINTENANCE FERTILIZER

Steps	Factors for Consideration
1. Determine type of turf to be grown	
2. Calculate P_2O_5, K_2O needed annually by turf species	

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STUDENT ACTIVITIES

SOILS AND FERTILIZERS
Definitions

Banding - Placing fertilizer in bands beside, above, and below the seed; fertilizer is available to plant's root system a few days after germination.

Fertilizer analysis - The percent of available primary nutrients (N,P,K).

Fertilizer, organic - Fertilizer produced by living plants and animals.

Fertilizer, inorganic - Fertilizer produced from minerals.

Gypsum - Mineral able to supply the essential nutrients of calcium and sulfur to a soil without changing the pH.

Leaching - The loss of dissolved nutrients with the downward movement of water through the soil.

Lime - Mineral applied to a soil to raise the pH.

Micro-nutrients - Boron, Chlorine, Manganese, Molybdenum, Iron, and Zinc; essential to plant growth in very small amounts - often referred to as trace elements.

Primary nutrients - Nitrogen, Phosphorus, and Potassium (N,P,K); required in large amounts by plants and not usually found in sufficient quantities in the soil.

Plant analysis - Studying the tissue of the plant to identify nutrient deficiencies.

pH - Measures the acidity of a soil with 7.0 being neutral on the scale of 0 to 14. Less than 7 is considered acidic while above 7 is considered basic (alkaline).

Secondary nutrients - Calcium, Magnesium, and Sulfur; not required in as large amounts as primary nutrients but still important to plant growth and development.

Soil structure - The way individual soil particles are grouped together to form clusters of particles (aggregates).

Soil test - Shows the breakdown of the total amount of nutrients available in the soil.

Soil texture - Refers to the size of the various particles that make up the soil.

SKILL EVALUATION FOR TAKING SOIL SAMPLES

_____ 1. Is the sample bag 1/2 full?

2. Is the sample bag properly labeled?

_____ date

_____ name

_____ address

_____ sample number

_____ field or location number

3. Is the sample information sheet properly filled out?

_____ past history

_____ site use

_____ fertilizer and lime used in the past and the date

_____ type of turf

_____ any unusual conditions

SOILS AND FERTILIZERS

Tilling the Seedbed and Applying Fertilizer

b 1. Used in poorly drained soils to improve drainage.

g 2. Slow water movement.

e 3. Rapid water movement.

g or h 4. Soil is difficult to till when wet.

c 5. Tool that completely turns over the soil.

d 6. Tool that makes a fine seedbed and is better than a disk.

a 7. Recommended soil pH.

j 8. Recommended optimum P_1 test.

i 9. Recommended optimum K test.

g or h 10. Moderate water movement.

a) 6.0-6.5
b) Tile
c) Plow
d) Rotary tiller
e) coarse and moderately coarse texture
f) medium texture
g) fine textures
h) fine textures
i) 260-300 lbs./acre
j) 40-50 lbs./acre

11. When should fertilizer be applied? Spring or fall

12. How much 12-12-12 should be applied to 1000 sq. ft. of lawn? 10 lbs.

13. What are the three methods of application of fertilizers?

spray, broadcast, band

SOILS AND FERTILIZERS

Taking Soil Samples and Testing Soil Samples

1. What is a problem soil area?

   Wet area, poor producing area, any unusual area

2. How many sample probes are required per 10,000 sq. ft.?

   (a) 1 b) 2 c) 5 d) 10

3. How much soil is required in the sample bag?

   a) 1 cup b) 1 quart c) 1/2 full (d) a and c)

4. To what depth should the soil sample be taken?

   a) 1 inch b) 2 inches (c) 3 inches) d) 6 inches

5. What information should be listed on the sample bag?

   Date
   Customer name
   Customer address
   Sample number
   Location (field) number
   Location on map

6. Where can you find information on the past history of a lawn?

   Old records; check old soil test results; ask owner

7. Soil samples should be mailed wet to keep the soil moist. True/(False)

8. Grinding the soil is only necessary when testing for pH. True/(False)

9. You should take one soil sample per every 40,000 sq. ft. True/(False)

10. What are three tools you could use to take soil samples?

    Auger
    Probe
    Spade

SOILS AND FERTILIZERS

Worksheet

1. If ammonium nitrate (30-0-0) costs $180 per ton, how much would a 50 lb. bag cost?

   $4.50 2000 lbs./50 lbs. per bag = 40 bags
   $180 ton/40 bags = 4.50 per bag

2. How much would each actual pound of nitrogen cost?

   26¢ 2000 x 34% = 680 lbs. actual N
   $180/ 680# = 26¢

3. If potash (0-0-60) is selling for $120 per ton, how much does 100 pounds of potash cost? How much does one actual pound of K_2O cost?

   $6.00 2000#/ 100# = 20 $120/20 = $6.00
   10¢ 2000# x 60% = 1200# $120/1200# = 10¢

4. Phosphate (0-440) fertilizer sells for $225 per ton. What does one pound of actual P_2O_5 sell for?

   26¢ 2000# x 44% = 880# $225/880# = 26¢

5. How many pounds of actual fertilizer nutrients is actually in 100 pounds of 12-12-12? 36#

   nitrogen = 12#
   P_2O_5 = 12#
   K_2O = 12#

6. If the soil test results are pH 6.0, P_2O_5 30, and K_2O 190 how many pounds of each is required to build up the soil per acre?

   lime = none
   P_2O_5 = 22#
   K_2O = 110#

7. If you need 4 tons of lime per acre, how much lime is that for 1000 sq. ft.?

   1 acre = 43,560 sq. ft.
   1000/43560 x 8000# of lime = 183.65# of lime per 1000 sq. ft.

SOILS AND FERTILIZERS

Student Activities

Activity 1

1. Take soil samples of a new lawn site that will be planted later to grass.
2. Analyze soil samples for pH, P and K.
3. Make fertilizer recommendation.
4. Fertilize and lime the site if needed.
5. Till 1/3 the site with a rotary tiller, 1/3 with a disk and 1/3 with a plow and disk. Compare the methods.
6. Seed the lawn.

Activity 2 - Larry's Lawn and Leisure

Larry is starting up his own business in the lawn care for homeowners. In his business he plans to prepare, fertilize, and seed new lawns or renovate old lawns for homeowners. Along with this he will also do landscaping, trimming, mowing, supply nursery stock, and sodding as part of his business.

Because of Larry's fast-growing business, he has hired several new employees to help him. Jim Jones just purchased a new home and has hired Larry to prepare, fertilize, and plant his new lawn. The lawn has 15,000 square feet in the back and 5000 square feet in the front of the house. Larry took one soil sample in the front yard and the results were pH 6.0, P_1 test 20# P_2O_5, and K test 200# K_2O. Larry's business is located in Springfield, Illinois, and the soil is a black clay loam.

Larry has assigned you to do the job. What, if any, mistakes has Larry made? How much lime and fertilizer will you apply to build up the soil? How many pounds of 12-12-12 will it take to fertilize the lawn after the build-up fertilizer is applied?

Activity 2 Key

1. Larry should have taken at least 2 soil samples--one in the front and one in the back yard.

2. Lime--none

   P_2O_5 56#/acre — 56/43560 sq.ft. x 1000 = 1.28# P_2O_5/1000 sq.ft.

   1/28 x 20 = 25.6# of P_2O_5 for the entire lawn

   K_2O 100#/acre — 100/43560 = 2.29# of K_2O/1000 sq.ft.

   2.29 x 20 = 45.8# of K_2O for the entire lawn

Extra - He can supply this with 58# of 0-44-0 and 76# of 0-0-60.

25.6/44% x 100 = 58 45.8/60% x 100 = 76

3. 10# of 12-12-12 per 1000 sq.ft. 10 x 20 = 200# of 12-12-12